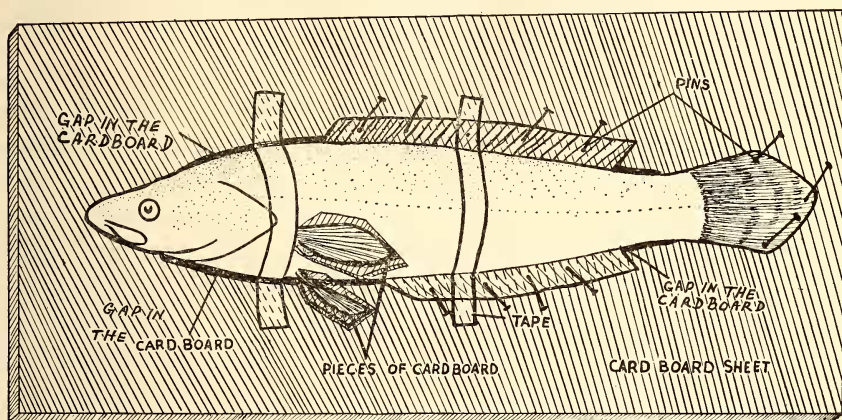


Fishes thus mounted on the cardboard are kept for a few minutes, preferably in the sun, until the fins have dried. They are then taken off and stored in separate jars containing either 70% alcohol or



formalin solution of suitable strength, which has previously been neutralised with borax. The entire process at first takes 15 to 25 minutes with each fish, but with a little practice it can be reduced to about 10 minutes.

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16. SOME LEAF-MINERS OF AGRICULTURAL IMPORTANCE IN NIZAMABAD DISTRICT OF ANDHRA PRADESH

Leaf-mining insects form an interesting group for study. The insect leaf-miners are all larvae belonging to one of the following orders, namely Lepidoptera, Coleoptera, Diptera, and Hymenoptera. Generally speaking, the majority of the leaf-miners are not of economic importance. According to Needham *et al.* (1928), in the United States of America the apple has at least ten different insect species that mine its leaves. Only two or three of them are of some importance, occasionally and in neglected orchards. Some of the leaf-miners

on agricultural crops are, however, sufficiently important to warrant control measures. Mention may be made of *Promecotheca reichei* Baly, the Coconut Leaf-miner, which is the most important pest of coconut in the Fiji Islands. In the following paper notes are given of some of the leaf-miners which are important as well as potentially important in Nizamabad district of Andhra Pradesh.

Nizamabad district which was formerly a part of Hyderabad State has a rich agricultural potential. Its importance has increased after the advent of the Nizamsagar Reservoir in the year 1950 by which three out of its five taluks have been able to get supplies of perennial irrigation water. The rainfall of the district averages 40 inches received mostly in the South-west Monsoon months of June, July, August, and September. The average maximum temperature varies from 75° F. to 106° F. and the average minimum from 50° F. to 89.9° F. The important crops grown are rice (*Oryza sativa*), jowar (*Andropogon sorghum*), and sugarcane (*Saccharum officinarum*).

Hispa armigera Ol. Rice Hispa. (Hispiinae, Chrysomelidae; Coleoptera.)

The grubs of this beetle mine the leaves of rice crop grown in both the seasons, viz. *Abi* and *Tabi*. While adult beetles scrape the epidermal layers of the leaf, the grubs mine into the leaves. Both the larval and pupal stages are passed in the leaf-mine itself. The reduction in yield ranges from 39-65% on normal average yields varying between 1200-2400 lb. per acre. In Nizamabad district the insect passes through six generations in a year on both the crops.

The eggs are laid in the leaf-tip of rice crop and normally hatch in about a week's time. The grub stage lasts 15-20 days, the grub feeding throughout in the same leaf mine. When two or more grubs attack the same leaf the different mines coalesce into one. The pupal period ranges from 6-10 days. The adult beetles live in confinement for a week to ten days. The complete life cycle occupies 30-35 days and does not vary much from year to year.

The natural enemies of Rice Hispa recorded in Nizamabad district are:

(i) *Bracon* sp. (Braconidae; Hymenoptera), which is a larval parasite on hispa grubs. The incidence of parasitism in nature ranges from 15-82%. A brief account of this parasite has been already given (Khan and Murthy, 1956).

(ii) *Eupteromalus* sp. near *nidulans* Forst. This is mostly a secondary parasite on *Bracon* sp. noted above and occasionally has also been observed as a primary larval parasite on hispa grubs. The incidence of parasitism (as a primary larval parasite) ranges from 2-5%.

(iii) An unidentified Cecidomyiid larval parasite. The incidence is negligible.

Pseudonapomyza atra Meigen (?). (Phytomyzinae, Agromyzidae; Diptera.)

This insect has come into prominence since 1952, when it appeared in appreciable numbers on the rice crop in the entire Nizamabad district. Formerly it had been observed mostly on grasses, the chief of which are *Cynodon dactylon*, *Eragrostis pilosa*, and *Setaria intermedia*. It has a widespread distribution having been recorded from Europe, Africa, North America, India, Malaya, and the Pacific Islands on a variety of graminaceous host plants.

The damage done to the paddy crop by *P. atra* consists of light-yellow apodous maggots mining the leaves and feeding on the mesophyll. The epidermal layers are not touched. The mines are linear but may turn into a blotch when more than one mine appear on the same leaf and spread over. In case of severe infestation, the leaves wither and fall off and the tillering is affected adversely.

August and September are the months of maximal activity of the insect. Routine sampling indicated the percentage of attack as varying from 15-50% on broadcast sown crop. Generally, not more than one maggot is observed in each leaf-mine. The pupation takes place inside the leaf-mine only. The entire life cycle of the insect is completed in 12-15 days. The flies are short-lived.

The natural enemies recorded on *P. atra* (Bap Reddy, 1956) are:

- (1) *Derostenus* sp.
- (2) *Achrysocharis* sp. (Euliphidae).
- (3) *Eucoilidea* sp. (Eucoilinae).

Apart from rice, *P. atra* is also recorded on maize (*Zea mays*) as well as ragi (*Elusine coracana* Gaert.) which is grown to a small extent in Kamareddi and Yellareddi taluks of the district.

Rhadinosa lebongensis Mlk. (Hispididae; Coleoptera).

This is a very minor insect pest of rice in the district. The adult beetle to the untrained eye resembles Rice Hispa (*H. armigera*) though the adults are smaller in size than the Rice Hispa. Body black, elytra shiny bluish black and nearly glabrous; form narrow and parallel-sided.

The life-history of *R. lebongensis* is similar to that of *Hispa armigera*. The adults scrape the epidermal layer of rice leaves while the grubs mine into the leaves. The duration of each stage noted

in the laboratory at a temperature averaging 84.5° F. (maximum) and 71.9° F. (minimum) is as follows:—

Grub stage—14 days (average)

Pupal stage—6 days (average)

The longevity of adults is 4-6 days. The entire life-cycle is roughly completed in 30-35 days.

Rhadinosa lebongensis has also been noted on *Echinochloa colonum* Link and *Panicum* spp. No larval parasites are noticed but the pupae are heavily parasitised by a chalcid (under identification), the incidence of parasitization ranging from 20-70%.

Adult beetles of *Rhadinosa lebongensis* have been observed to scrape the leaves of sugarcane but no leaf-mining by the maggots has been observed.

Other minor leaf miners which have been observed in Nizamabad district but on which studies have not been conducted are the citrus leaf-miner *Phyllocristis citrella* S., found on young plants of Nimbu and Mosambi (*Citrus aurantifolia*, *C. limetioides*) and the leaf-mining weevil on Mango (*Rhynchoerus mangiferae* M.).

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GLOSSARY

Abi: Monsoon crop, sown in June-July and harvested in November-December.

Tabi: Second season crop, sown in January-February and harvested in April-May.

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REFERENCES

1. Bap Reddy, D. (1956) : *Pseudonapomyza atra* on Maize leaves. *Curr. Sci.* 25 (5) : 160.
2. Khan, M. Q. and Murthy, D. V. (1954) : A preliminary note on a larval parasite on the rice hispa. *Ind. J. Ent.* 16.
3. Needham, J. G., Frost, S. W., and Tothill, B. H. (1928) : *Leaf-mining Insects*. Bailliere, Tindall & Cox, London, 351 pp.